



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Changes in Marijuana and Nicotine Vaping Perceptions and Use Behaviors among Young Adults since the COVID-19 Pandemic: A Qualitative Study

Kathleen R. Case, Stephanie L. Clendennen, Jay Shah, Joel Tsevat, Melissa B. Harrell

PII: S2352-8532(22)00003-7
DOI: <https://doi.org/10.1016/j.abrep.2022.100408>
Reference: ABREP 100408

To appear in: *Addictive Behaviors Reports*

Received Date: 9 August 2021
Revised Date: 17 December 2021
Accepted Date: 16 January 2022



Please cite this article as: K.R. Case, S.L. Clendennen, J. Shah, J. Tsevat, M.B. Harrell, Changes in Marijuana and Nicotine Vaping Perceptions and Use Behaviors among Young Adults since the COVID-19 Pandemic: A Qualitative Study, *Addictive Behaviors Reports* (2022), doi: <https://doi.org/10.1016/j.abrep.2022.100408>

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Changes in Marijuana and Nicotine Vaping Perceptions and Use Behaviors among Young Adults since the COVID-19 Pandemic: A Qualitative Study

Kathleen R. Case, DrPH^{a,b,*}, Stephanie L. Clendennen, DrPH^c, Jay Shah, MPH^c, Joel Tsevat, MD^{a,b} and Melissa B. Harrell, Ph.D., MPH^c

^aCenter for Research to Advance Community Health (ReACH), Joe R. and Teresa Lozano Long School of Medicine, The University of Texas Health Science Center at San Antonio, 7411 John Smith Drive, Suite 1050, San Antonio, TX, 78229, United States

^bDepartment of Medicine, Joe R. and Teresa Lozano Long School of Medicine, The University of Texas Health Science Center at San Antonio, 7703 Floyd Curl Drive, San Antonio, TX 78229

^cUT Health, UT Health Science Center at Houston, School of Public Health, Austin Campus, 1616 Guadalupe Street, Suite 6.300, Austin, TX, 78701, United States

***Corresponding Author: Kathleen Case, casek1@uthscsa.edu, 7411 John Smith Drive, Suite 1050, San Antonio, TX, 78229**

Abstract

Background: Research is lacking on the impact of the COVID-19 pandemic on marijuana vaping behaviors; a notable limitation as marijuana vaping has been previously associated with respiratory issues among young people. This qualitative study explored how the COVID-19 pandemic influenced vaping perceptions and behaviors among young adults (18 to 25-year-olds). **Methods:** Qualitative interviews were conducted with 50 regular marijuana vapers.

Individuals were eligible if they vaped marijuana at least 3 days per week (exclusively or dual use with nicotine). Interview transcripts were analyzed using deductive coding processes to identify themes. Differences in themes by gender and user status (regular marijuana versus regular dual vapers) were explored. **Results:** While many participants indicated that the pandemic negatively impacted their attitudes about vaping, participants also noted that their negative attitudes did not translate into reductions in use. Overall, 54% of participants reported increasing vaping during COVID-19. For both regular dual vapers and marijuana vapers, boredom was a prominent theme for increases in vaping. Lack of accessibility of marijuana was cited as a reason for decreasing marijuana among regular marijuana vapers but not for regular dual vapers. Males reported more unchanged attitudes about vaping and more males than females reported still sharing their devices. **Conclusions:** More than half of participants reported increasing their vaping behaviors since the COVID-19 pandemic despite concerns about the potential for vaping to adversely impact lung and immune health. As the U.S. adapts to the COVID-19 pandemic, interventions should address factors that may contribute to increases in use behaviors.

Keywords: vaping, marijuana, COVID-19, young adults, e-cigarettes

1.0 Introduction

Prior to the emergence of COVID-19, the U.S. witnessed an increase in the use of novel tobacco products like e-cigarettes. From 2017 to 2018, current (past 30-day) e-cigarette use rose by 46% among young adults (18-24 year-olds).^{1,2} According to more recent data, in 2019, 9.3% of 18 to 24-year-olds reported current (i.e. now using e-cigarettes on “some” or “most days”) e-cigarette use.³ Similarly, vaping has become a popular method for using marijuana products among young people. The prevalence of marijuana vaping during the past 30 days among 19 to 22 year-olds more than doubled from 2017 to 2019 (5% versus 14%).⁴

Researchers also found that younger adults (18 to 24 year-olds) reported the highest

prevalence of past 30-day marijuana vaping as compared with older age groups.⁵ Notably, nicotine and marijuana vaping are closely linked behaviors.^{6,7} In one of the only longitudinal studies to explore the association between e-cigarette use and marijuana vaping among college students in Hawaii (18-25 year-olds), Pokhrel et al. (2020) found that current (past 30-day) use of e-cigarettes at baseline significantly predicted the initiation and escalation of marijuana vaping at 1 year follow-up (adjusted odds ratio (“AOR”)= 4.63 and 1.19, respectively).

To date, limited research has investigated the impact of the COVID-19 pandemic on vaping (marijuana and/or nicotine) use behaviors among young adults and potential reasons for the observed changes in behaviors.^{8,9} In one study examining changes in vaping behaviors during the COVID-19 pandemic among 18 to 25 year-olds recruited from outpatient settings in the Midwest, researchers found that roughly one third of participants reported a change in their substance use behaviors (e.g. alcohol, vaping, marijuana). Overall, 9.6% of young adults increased vaping behaviors, while 15.1% decreased vaping. For marijuana, 13.4% of participants increased use, while 12.3% decreased use.⁹ Furthermore, Kale et al (2021) found that among current vapers in the UK (adults 18 and older), boredom, and staying at home, were the most commonly cited reasons for increases in vaping use since the pandemic.⁸ Notably, in both these studies, authors surveyed vapers generally and did not indicate whether they vaped marijuana or nicotine.

The lack of research exploring marijuana vaping behaviors among young people is a significant gap in the literature, particularly in light of a worldwide respiratory pandemic. While research on the long-term health impacts of vaping use (marijuana and/or nicotine) are still under investigation, a previous outbreak of a pneumonia-like illness underscored the potential risk for respiratory complications of marijuana vaping.¹⁰ E-cigarette, or vaping, associated lung injury (EVALI) emerged in Spring 2019; roughly 3,000 cases and 68 deaths were reported across the U.S.¹⁰ Vitamin E acetate, an additive found in some marijuana vape products, was

implicated in the development of EVALI.¹¹ In addition to EVALI, emerging research suggests that marijuana vaping may negatively impact respiratory health.¹² In a study of young adult vapers in Southern California (mean age=19.3 years), researchers found that vaping marijuana (3 or more days in the past 30 days), was associated with increased odds of bronchitic symptoms (AOR=2.19, 95% CI=1.18-4.06) and wheeze (AOR=2.27, 95% CI=1.17-4.37) after controlling for sociodemographic variables, as well as other vaping and combustible tobacco use behaviors.¹² These findings, coupled with the EVALI epidemic, have raised public health concerns over the dangers of marijuana vaping among young people.¹³

The purpose of this qualitative study was to explore how the COVID-19 pandemic influenced vaping (marijuana and nicotine) perceptions and behaviors among 18 to 25-year-olds, as well as to explore potential differences by gender and user type (regular marijuana versus regular dual vapers). Items assessed included the impact of the COVID-19 pandemic on vaping perceptions and behaviors, and reasons for changes in use.

2.0 Materials and Methods

2.1 *Participants and recruitment*

Fifty young adult marijuana vapers in Texas were recruited from 1) a cohort study of youth and young adults, the Texas Adolescent and Tobacco Marketing Surveillance System (TATAMS), 2) a university-wide event calendar, and 3) referrals from individuals who completed the qualitative interviews. Inclusion criteria included 1) 18 to 25 years of age, 2) residents of the state of Texas, and 3) regular marijuana vaping exclusively or in combination with nicotine. Regular marijuana vaping was defined as vaping marijuana at least 3 days per week. Individuals who reported regular vaping of both marijuana and nicotine (at least 3 days per week) were classified as “regular dual vapers,” those who reported regular vaping of marijuana only were classified as “regular marijuana vapers.” Participants were given a \$100 gift card for

their participation. This study was reviewed and approved by the University of Texas School of Public Health Committee for the Protection of Human Subjects.

2.2 Data collection and analysis

Qualitative interviews were conducted from September 2020 to April 2021. The principal investigator (K.C.) and graduate research assistant (J.S.) conducted the interviews via Zoom. A qualitative interview guide was created to assess the impact of COVID-19 on 1) opinions or attitudes about vaping, and 2) vaping use behaviors, including reasons for changes in use behaviors. The baseline screener assessed demographics and vaping use behaviors for both marijuana and nicotine.

Qualitative Analysis

Interviews were transcribed using a professional service; original recordings were referenced to clarify any omissions in the transcriptions. Transcripts were then imported into NVIVO 12 for analysis; all transcripts were coded for themes using a thematic analysis framework.¹³ Interview transcripts were analyzed using deductive coding processes to identify and label themes using the pre-determined constructs included in the interview guide. After the initial coding for major themes, an inductive coding process was used to identify common subthemes and codes.¹³ K.C. was responsible for creating the codebook and coding all interviews; S.C. reviewed the codes and checked for any discrepancies in themes. Discrepancies were discussed until a consensus for coding was reached.

3.0 Results

3.1 Sample Characteristics

Of the 50 participants, 30 were male and 20 were female, the mean [SD] age was 21.4 [1.9] years. Forty percent of participants were Asian; 18% White, non-Hispanic; 20% Hispanic;

18% African American, and 4% indicated another race. Twenty-two participants (44%) were classified as regular marijuana vapers, while 28 (56%) met the criteria for regular dual vapers (Table 1). Overall, 27 participants (54%) reported increasing vaping behaviors since the pandemic, while 10 (20%) reported decreasing use.

3.2 Changes in Attitudes about Vaping due to COVID-19

For both regular dual vapers and regular marijuana vapers, the most prominent categories regarding the impact of COVID-19 on vaping perceptions were 1) unchanged attitudes or 2) more negative attitudes. Two participants noted that they had seen stories on social media warning of the dangers of COVID-19 and vaping, but they were not swayed by such messages. “I do see a bit more information about it on like social media saying that vapers are at a higher risk for developing more severe symptoms. But I don’t think it’s changed my perception of it” (Male, regular dual vaper, participant #1). Another participant noted the lack of conclusive evidence between vaping and severity of COVID-19 infection:

There were some random tests here and there saying the effects of vaping nicotine and the effects of vaping marijuana and relating to if you contracted COVID-19... But it never really was on my mind too much because it was never set in stone (Male, regular dual vaper, participant #2).

Conversely, participants who reported more negative attitudes about vaping since the onset of COVID-19 noted concerns about the potential impact of vaping on lung and immune health, which might predispose someone to COVID-19 or worsen health outcomes. One participant stated, “I heard that vaping could make you more susceptible to either getting it or getting sick from it. But yeah, that made me nervous about vaping, for sure” (Female, regular marijuana vaper, participant #3).” Another participant noted the potential impact of vaping on respiratory health, “I mean, given that it is a respiratory illness definitely makes you think twice

about inhaling things into your lungs for...a while” (Male, regular marijuana vaper, participant #4).

Several participants noted that while their views on vaping were more negative, it did not necessarily translate into changes in use behaviors, “It [COVID-19] makes me more hesitant to use all of this for sure, but I still do it on a daily basis” (Male, regular dual vaper, participant #5). Another participant stated, “I think I’ve been more conscious of it [vaping during COVID-19]. My attitude of it [vaping] is I think about it a lot more, but I also don’t make that extra leap to convince myself that it’s a problem” (Female, regular marijuana vaper, participant #6).

3.2.1 Differences by gender and user status

Attitudes about vaping remained unchanged since the COVID-19 pandemic for males, while, for females, their attitudes were more negative due to health concerns. Both regular dual vapers and regular marijuana vapers reported similar themes regarding attitudes about vaping since the start of the COVID-19 pandemic.

3.3 Reasons for Changes in Vaping Use Behaviors due to the COVID-19 pandemic

As we observed differences in themes by user status, we describe both common and divergent themes. The most prominent theme for both regular marijuana and regular dual vapers was an increase in vaping behaviors due to boredom. For example, one participant stated, “I’m usually bored and I just like to feel the less-- I have the feeling of boredom. So the only thing I have to turn to is marijuana... I tend to vape more marijuana than I used to before COVID pandemic” (Female, regular dual vaper, participant #7). Another participant shared similar feelings, stating that his marijuana vaping increased because “When we’re at home, we get kind of bored with all the mundane things, and we use that to make things a little more fun” (Male, regular dual vaper, participant #8). When discussing the source of the boredom, participants noted that both classes and often jobs are remote, thus increasing the time at home.

Another common theme for changes in vaping behaviors since COVID-19 for both marijuana and dual vapers included changes in social interactions. Changes in social interactions were cited as reasons for both decreasing and increasing vaping behaviors, although the most common theme was reduced social interactions led to decreases in vaping behaviors. Examples of changes in social interactions included interacting with friends less frequently due to social distancing guidelines. Another participant explained the link between less social interaction and decreased vaping:

The lack of a social setting has helped me not vape as much, really, because when I'm with my friends, most of my friends vape. And because they're vaping around me, I feel more inclined to continue doing it myself (Female, regular marijuana vaper, participant #9).

Another participant noted that he considers himself a social user and, therefore, fewer social interactions led to reductions in vaping, "With vaping, I've been smoking less because, [I'm] a social smoker. But with quarantine, [I] definitely haven't been hanging out as much so I would say my use has gone down a little bit" (Male, regular dual vaper, participant #10). Notably, however, a couple of participants noted the change in social interactions as a reason for increasing use, due to a lack of pressure to not vape:

I feel it's [vaping] gotten more prominent, just because in public, I would do it less. In areas where it's just not allowed, I wouldn't want to be seen doing it. So now that I'm home, it's kind of just like a private area where no one watches (Female, regular marijuana vaper, participant #11).

Another participant echoed similar thoughts pointing out that he is less exposed to anti-vaping messages:

[The] lack of external pressure [is the reason for increased vaping]. There's less physical voices present, like whenever I walk out, there's always someone saying 'stop vaping, stop smoking, stop nicotine.' And whenever I hear that, I guess that it's like a reminder that I should stop. With spending a lot of time inside, I definitely feel like it's easy to disconnect from everything (Male, regular dual vaper, participant #12).

Lack of accessibility of marijuana vape products emerged as a prominent reason for changes in vaping behaviors among marijuana vapers, but not for dual vapers. Specifically, participants stated the COVID-19 pandemic led to a lack of accessibility of marijuana vape products relative to that of nicotine products, leading to vaping less marijuana. When elaborating on why marijuana products are less accessible participants noted that they are dispersed from their normal sources of the product due to people moving home, living at home with parents, and lack of disposable income for purchasing marijuana. For example, one participant stated, "I don't really want to go out to get carts [marijuana cartridges] from someone that I don't really know" and contrasted that with the ease of purchasing nicotine products, "but a vape, you could just go to the store and grab one." (Female, regular marijuana vaper, participant #13). Moving back home with parents and the relative cost of marijuana products were also factors in decreasing use, "I lost my job due to the pandemic, so I don't really have as much disposable money to just be throwing around. It can add up pretty quickly how much it [marijuana vape products] cost" (Male, regular marijuana vaper, participant #4).

3.3.1 *Differences by gender and user typer*

Males and females reported similar reasons for changes in vaping use behaviors due to the COVID-19 pandemic. As noted above, the most common themes for changes in vaping use for regular dual vapers included boredom and changes in social interactions, while the most common themes for regular marijuana vapers included boredom, lack of accessibility, followed by changes in social interactions.

3.4 *Sharing Devices*

As a result of the COVID-19 pandemic, most participants indicated that they do not share their device now, or only do so occasionally. The rationale for not sharing devices was to protect against spreading the virus, “That's a big no-go [sharing devices] now just because you never know if someone has COVID and is asymptomatic and doesn't know they're positive yet” (Female, regular marijuana vaper, participant #14). In general, participants recognized the dangers of sharing their devices, however, some reported still sharing their devices with close contacts such as significant others, roommates, and close friends. One participant described how he perceived sharing vaping devices with close friends as minimal risk, “[I share] because I know where they've [close friends] been. We've only been with each other so there's less of scare” (Male, regular marijuana vaper, participant #15).

3.4.1 *Differences by gender and user type*

Both user types reported similar themes, however, more males than females noted still sharing their devices despite the pandemic.

4.0 Discussion

Results from our qualitative interviews provide insight into vaping behaviors of young adults since the start of the COVID-19 pandemic. Notably, more than half of participants reported increases in vaping use behaviors. For both user groups, boredom was the most salient reason for changes in vaping behaviors. A theme unique to marijuana vapers was the lack of accessibility to marijuana, leading to reductions in use. Another notable finding includes the incongruence between changes in vaping perceptions and continued use behaviors in the face of a global respiratory pandemic. We also observed divergent themes for changes in attitudes toward vaping by gender: males generally indicated that their attitudes toward vaping remained unchanged since the pandemic, while females stated that their attitudes were more

negative. Similarly, more males still shared their devices compared to females who were generally reported reductions in sharing behaviors. Implications for future research and interventions are discussed.

One notable finding included the incongruence between changes in perceptions of vaping due to COVID-19 and continued vaping behaviors. While previous research has demonstrated the gap between negative attitudes and changes in smoking behaviors,¹⁴ this study is one of the first to document this phenomenon in the context of the COVID-19 pandemic and vaping behaviors.⁸ In our study, many participants were apprehensive about vaping during the pandemic, citing concerns about vaping worsening lung and immune health. Those concerns notwithstanding, many participants also reported increasing use throughout the pandemic. These seemingly contradictory findings might be explained by optimism bias, the tendency for individuals to discount the risk of personal harm of a negative outcome (e.g. disease or illness).¹⁵ The role of optimism bias has been well-documented for cigarette smoking; Arnett and co-authors (2000) found that younger smokers (12 to 17 years old) were more likely to discount personal harm of cigarette use than older smokers (30 to 50 years old).¹⁶ Specific to COVID-19, a recent study found that college students reported greater concern for the health effects of COVID-19 for others (e.g. family, friends) than for themselves.¹⁷ Ultimately, young adult vapers may perceive lower personal risk of complications from COVID-19 due to vaping and not be motivated to quit as a result. Public health interventions aimed at decreasing vaping behaviors (both marijuana and nicotine) should incorporate messaging to counter optimism bias in order to encourage cessation among young adults.

Another explanation for the disconnect between changes in perceptions of vaping and failing to quit may also be the lack of consistent evidence linking vaping and COVID-19 outcomes. While there have been messages from health organizations, such as the American Lung Association, warning of the potential for vaping nicotine to worsen COVID-19, scientific

findings linking the two are scant.¹⁸ One study found that prevalence of e-cigarette use at the state level was positively associated with the incidence of COVID-19, as well as deaths from COVID-19 after controlling for statewide demographics and additional risk factors, including cancer, obesity, and smoking prevalence, among others.¹⁹ In contrast, however, there were also unsubstantiated reports that nicotine was actually protective against COVID-19 infection, with such sentiments circulating on social media websites such as Twitter.²⁰ Notably, there have not been similar warnings regarding the potential dangers between vaping marijuana and COVID-19 susceptibility and severity. This is a notable gap, as highlighted by Borgonhi et al. (2021): although marijuana use could predispose individuals to worse COVID-19 health outcomes, studies specific to vaping marijuana and COVID-19 infection and severity are currently lacking.²¹ Ultimately, as the research examining the associations (or lack thereof) between vaping and COVID-19 advances, the scientific community should utilize communication channels that are frequently used by young adults, particularly social media (e.g., Twitter, Facebook, Instagram) to disseminate results.

Differences in common themes by gender and user type also merit discussion. For example, more males stated that their opinions on vaping were unchanged since the pandemic and they reported still sharing their devices more frequently than females. These findings, particularly with respect to sharing vaping devices, suggest that males may not feel the need to change their vaping behaviors to reduce their risk of COVID-19 infection. One rationale for these gender differences could be in differences in perceptions of risk, in this case, the potential risk of contracting COVID-19 from sharing devices. Our findings are consistent with previous research suggesting that males report lower risk perceptions for negative health outcomes (including death from COVID-19) than females.²²⁻²⁴ Finally, lack of accessibility of marijuana was noted as a reason for decreasing use for marijuana vapers but not for dual vapers. These findings may be explained by the differing legal status of the products in Texas; notably,

recreational and medicinal marijuana use is still prohibited, therefore, young adults must purchase the products from the black market as opposed to purchasing commercially. Since dual vapers report regular use of both nicotine and marijuana, the lack of accessibility may not have been as impactful on vaping behaviors as compared to individuals who only regularly vape marijuana.

Strengths and Limitations

The main strength of the study is that it is the first, to our knowledge, to investigate changes in marijuana vaping behaviors (exclusively or dual use with nicotine) among young adults since the COVID-19 pandemic. Importantly, however, there are several limitations that warrant discussion. First, participants were a convenient sample of regular vapers and are not representative of all young adult vapers. In addition, as we utilized referral recruitment strategies, this may reduce the diversity of experiences and opinions of participants, and, therefore, further limit the generalizability of our results. Furthermore, as data were collected at one period of time, we were not able to determine how vaping use behaviors changed over the course of the pandemic. Finally, all measures were self-report, therefore, we cannot objectively confirm vaping use behaviors. Importantly, however, our sample was highly diverse, and self-report measures are frequently used to assess vaping use behaviors among young adults.

Conclusion

In conclusion, as vaccination rates across the U.S. increase, daily life is slowly normalizing, with colleges and universities resuming in-person classes in Fall 2021.^{25,26} With this shift back to pre-pandemic activities, there is a continued need to 1) assess how COVID-19 impacted substance use behaviors among young people, including vaping marijuana and nicotine, and 2) refine public health messages to reflect evolving research on the association between vaping and COVID-19 infection and outcomes. Even as vaccination rates increase

across the U.S.,²⁷ scientists predict that we will continue living with COVID-19 for the foreseeable future.²⁸ As a result, it is important that public health messaging regarding the harms of vaping incorporate the most up-to-date research on whether vaping may influence COVID-19 susceptibility and severity among young people. Furthermore, as male vapers reported 1) more unchanged attitudes toward vaping and 2) continuing to share their devices as compared to females, tailored messages for young adult males that highlight the concerns associated with COVID-19 and vaping may be warranted. Messages should highlight how young adult males may be at higher risk of COVID-19 infection than other demographic groups,²⁹ as well as discuss how males, generally, are more likely to suffer adverse outcomes from COVID-19 than females.^{30,31}

Table 1: Characteristics of Regular Dual Vapers (marijuana and nicotine) and Regular Marijuana Vapers

	Regular Dual Vapers (n=28) n (%), m (sd)	Regular Marijuana Vapers (n=22) n (%), m (sd)
Gender		
Male (n=30)	23 (82.1)	7 (31.8)
Female (n=20)	5 (17.9)	15 (68.2)
Age	21.9 (2.1)	20.7 (1.4)
Race/ethnicity		
White, non-Hispanic (n=9)	5 (17.9)	4 (18.2)
Hispanic (n=10)	5 (17.9)	5 (22.7)
Black or African American (n=9)	8 (28.6)	1 (4.6)
Asian (n=20)	10 (35.7)	10 (45.5)
Other (n=2)	--	2 (9.1)
Highest education level		
High school graduate/GED (n=5)	4 (14.3)	1 (4.6)
Some college (n=32)	13 (46.4)	19 (86.4)
College graduate (n=7)	5 (17.9)	2 (9.1)
Some graduate school (n=3)	3 (10.7)	--
Graduate degree (n=3)	3 (10.7)	--
Change in vaping use behaviors since COVID-19 ¹		
Increase (n=27)	17 (60.7)	9 (45.5)
Decrease (n=10)	3 (10.7)	7 (31.8)
Stayed the same (n=10)	7 (25.0)	3 (13.6)
Mixed (n=3)	1 (3.6)	2 (9.1)

¹Participants were asked to describe their vaping behaviors since the start of the COVID-19 pandemic.

Individuals who reported that use one substance increased, while use of another decreased were coded as "Mixed."

CITATIONS

- [1] Gentzke AS, Creamer M, Cullen KA, et al. Vital signs: tobacco product use among middle and high school students — United States, 2011–2018. *Morb Mortal Wkly Rep*. 2019;68(6):157-164. doi:10.15585/mmwr.mm6806e1
- [2] Dai H, Leventhal AM. Prevalence of e-cigarette use among adults in the United States, 2014-2018. *JAMA*. 2019;322(18):1824-1827. doi:10.1001/jama.2019.15331
- [3] Cornelius ME, Wang TW, Jamal A, et al. Tobacco product use among adults- United States, 2019. *Morb Mortal Wkly Rep*. 2020;69. Doi: 10.15585/mmwr.mm6946a4
- [4] Knopf A. Vaping nicotine and marijuana more than doubles among college-age students. *Brown Univ Child Adolesc Behav Lett*. 2020;36(11):6-7. doi:https://doi.org/10.1002/cbl.30502
- [5] Uddin SMI, Osei AD, Obisesan OH, et al. Prevalence, trends, and distribution of nicotine and marijuana use in e-cigarettes among US adults: the Behavioral Risk Factor Surveillance System 2016–2018. *Prev Med*. 2020;139:106175. doi:10.1016/j.ypmed.2020.106175
- [6] Kowitt SD, Osman A, Meernik C, et al. Vaping cannabis among adolescents: prevalence and associations with tobacco use from a cross-sectional study in the USA. *BMJ Open*. 2019;9(6):e028535. doi:10.1136/bmjopen-2018-028535
- [7] Pokhrel P, Fagan P, Kawamoto CT, Okamoto SK, Herzog TA. Predictors of marijuana vaping onset and escalation among young adults. *Drug Alcohol Depend*. 2020;216:108320. doi:10.1016/j.drugalcdep.2020.108320
- [8] Kale D, Herbec A, Perski O, Jackson SE, Brown J, Shahab L. Associations between vaping and Covid-19: cross-sectional findings from the HEBECO study. *Drug Alcohol Depend*. 2021;221:108590. doi:10.1016/j.drugalcdep.2021.108590
- [9] Sharma P, Ebbert JO, Rosedahl JK, Philpot LM. Changes in substance use among young adults during a respiratory disease pandemic. *SAGE Open Med*. 2020;8:2050312120965321. doi:10.1177/2050312120965321
- [10] Centers for Disease Control and Prevention. Smoking and tobacco use: outbreak of lung injury associated with the use of e-cigarette, or vaping, products. Available at: https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html. Accessed July 3, 2020.
- [11] Blount BC, Karwowski MP, Shields PG, et al. Vitamin E acetate in bronchoalveolar-lavage fluid associated with EVALI. *N Engl J Med*. 2020;382(8):697-705. doi:10.1056/NEJMoa1916433
- [12] Braymiller JL, Barrington-Trimis JL, Leventhal AM, et al. Assessment of nicotine and cannabis vaping and respiratory symptoms in young adults. *JAMA Netw Open*. 2020;3(12):e2030189. doi:10.1001/jamanetworkopen.2020.30189

- [13] King BA, Jones CM, Baldwin GT, Briss PA. The EVALI and youth vaping epidemics — implications for public health. *N Engl J Med*. 2020;382(8):689-691. doi:10.1056/NEJMp1916171
- [14] De Leeuw RNH, Engels RCME, Vermulst AA, Scholte RHJ. Do smoking attitudes predict behaviour? A longitudinal study on the bi-directional relations between adolescents' smoking attitudes and behaviours. *Addiction*. 2008;103:1713-1721.
- [15] Weinstein ND. Optimistic biases about personal risks. *Science*. 1989;246(4935):1232-1234.
- [16] Arnett JJ. Optimistic bias in adolescent and adult smokers and nonsmokers. *Addict Behav*. 2000;25(4):625-632. doi: 10.1016/S0306-4603(99)00072-6
- [17] Charles NE, Strong SJ, Burns LC, et al. Increased mood disorder symptoms, perceived stress, and alcohol use among college students during the COVID-19 pandemic. *Psychiatry Res*. 2021;296:113706. doi:10.1016/j.psychres.2021.113706
- [18] American Lung Association. Media advisory: COVID-19: worse for smokers, e-cigarette users. Available at: <https://www.lung.org/media/press-releases/covid-19-worse-for-smokers-e-cigarette-users>. Published April 1, 2020. Accessed May 5, 2021.
- [19] Li D, Croft DP, Ossip DJ, Xie Z. The association between statewide vaping prevalence and COVID-19. *Prev Med Rep*. 2020;20:101254. doi:10.1016/j.pmedr.2020.101254
- [20] Majmundar A, Allem J-P, Cruz TB, Unger JB. Public health concerns and unsubstantiated claims at the intersection of vaping and COVID-19. *Nicotine Tob Res*. 2020;22(9):1667-1668.
- [21] Borgonhi EM, Volpatto VL, Ornell F, Rabelo-da-Ponte FD, Kessler FHP. Multiple clinical risks for cannabis users during the COVID-19 pandemic. *Addict Sci Clin Pract*. 2021;16(1):5. doi:10.1186/s13722-021-00214-0
- [22] Dryhurst S, Schneider CR, Kerr J, et al. Risk perceptions of COVID-19 around the world. *J Risk Res*. 2020;23(7-8). doi:10.1080/13669877.2020.1758193
- [23] Brown R, Coventry L, Pepper G. Information seeking, personal experiences, and their association with COVID-19 risk perceptions: demographic and occupational inequalities. *J Risk Res*. 2021;24(3-4):506-520. doi:10.1080/13669877.2021.1908403
- [24] Sund B, Svensson M, Andersson H. Demographic determinants of incident experience and risk perception: do high-risk groups accurately perceive themselves as high-risk? *J Risk Res*. 2017;20(1):99-117. doi:10.1080/13669877.2015.1042499
- [25] Kreidler M. Colleges and universities plan for normal-ish campus life in the fall. *US News & World Report*. March 29, 2021. Accessed May 5, 2021. <https://www.usnews.com/news/health-news/articles/2021-03-29/colleges-and-universities-plan-for-partially-normal-campus-life-in-the-fall>.

- [26] Hartocollis A. Some colleges and universities are planning for a 'more normal' fall semester. *The New York Times*. February 27, 2021. Accessed May 5, 2021. <https://www.nytimes.com/2021/02/26/world/universities-colleges-reopening-covid.html>.
- [27] Ivory D, Smith M, Lee J, Walker A, et al. See how the vaccine rollout is going in your county and state. *The New York Times*. Updated May 26, 2021. Accessed May 26, 2021. <https://www.nytimes.com/interactive/2020/us/covid-19-vaccine-doses.html>.
- [28] Mandavilli A. Reaching 'herd immunity' Is unlikely in the U.S., experts now believe. *The New York Times*. May 3, 2021. Accessed May 5, 2021. <https://www.nytimes.com/2021/05/03/health/covid-herd-immunity-vaccine.html>.
- [29] Fisman DN, Greer AL, Brankston G, et al. COVID-19 case age distribution: correction for differential testing by age. *Ann Intern Med*. 2021;174(10):1430-1438. doi:10.7326/M20-7003
- [30] Griffith DM. Men and COVID-19: a biopsychosocial approach to understanding sex differences in mortality and recommendations for practice and policy interventions. *Prev Chronic Dis*. 2020;17. doi:10.5888/pcd17.200247
- [31] Klein SL, Dhakal S, Ursin RL, Deshpande S, Sandberg K, Mauvais-Jarvis F. Biological sex impacts COVID-19 outcomes. *PLOS Pathog*. 2020;16(6):e1008570. doi:10.1371/journal.ppat.1008570

Highlights

- More than half of marijuana vapers in this study increased use during COVID-19.
- Participants noted that COVID-19 led to more negative attitudes about vaping.
- Changes in attitudes about vaping did not translate into reductions in vaping use.
- Boredom was a common theme for increasing vaping.

Contributors: All authors participated in the research and/or article preparation process.

Kathleen Case, DrPH: funding acquisition, conceptualization, formal analysis, and writing-original draft. Stephanie Clendennen, DrPH: formal analysis, validation, writing-review and editing. Jay Shah, MPH: data curation, project administration, writing-review and editing. Joel Tsevat, MD, MPH: writing-review and editing, resources. Melissa Harrell, PhD: funding acquisition, conceptualization, writing-review and editing.

Disclosures

Role of Funding Source: Research reported in this paper was supported by grant number [R01-CA239097] from the National Cancer Institute. All individuals who contributed significantly to the work are listed as authors. This work has not been presented at any conferences.

Contributors: All authors participated in the research and/or article preparation process. Kathleen Case, DrPH: Conducted qualitative interviews, coded all interviews, conducted qualitative analysis, prepared the manuscript. Stephanie Clendennen, DrPH: Reviewed the common themes for clarity and agreement, aided in the review of the article. Jay Shah, MPH: Conducted qualitative interviews and reviewed the finalized manuscript. Joel Tsevat, MD, MPH: Reviewed the manuscript and edited for clarity. Melissa Harrell, PhD: Procured funding for the original grant, provided feedback on the manuscript from conceptualization to final editing.

Conflict of Interest: Dr. Harrell is a consultant in litigation involving the vaping industry. Other authors have no conflicts of interest to disclose. **Acknowledgments:** None.

Conflict of Interest: Dr. Harrell is a consultant in litigation involving the vaping industry. Other authors have no conflicts of interest to disclose.